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Review Article

MEDICINALLY IMPORTANT PLANT *CLEOME GYNANDRA:* A PHYTOCHEMICAL AND PHARMACOLOGICAL EXPLANATION

PARTHA PRADIP ADHIKARI[1,2]*, SATYA BHUSAN PAUL[2]

[1]Genoine Research Laboratory Pvt. Ltd., Subhash Nagar, Karimganj - 788710, Assam, India. [2]Department of Chemistry, Assam University, Silchar - 788 011, Assam, India. Email: dr.parthaadhikari@gmail.com

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ABSTRACT

Cleome genus includes 601 plant species from the family Cleomaceae. Of more than 600 plants, 206 (34.3%) plants are having accepted species names. *Cleome gynandra* Linn. is a well-known medicinal plant with traditional and pharmacological importance. A good number of secondary plant metabolites have also been isolated from different parts of *C. gynandra*. Our investigation confirms two mutant varieties of *C. gynandra* exists in India. Accordingly, the objective of this study was designed to critically evaluate the pharmacological and phytochemical evaluation of *C. gynandra* of two mutant variety, to provide a consolidated platform for research potential of both the mutant varieties of *C. gynandra*. Careful scrutiny reveals that the plant possesses a huge range pharmacological applications, such as anti-inflammatory, free radical scavenging, anticancerous, immunomodulator, and antidiabetic agents. To arrive its pharmacological importance the published papers also shown an enormous amount of phytochemicals endorsement. Scientific perusal reveals different parts of the plant has an immense medicinal importance which proofs its traditional use round the glove. But in North-Eastern region of India, the same plant abundantly found in pink mutant variety. To date, there is not much research investigation for this mutant variety to validate its pharmacological importance. Therefore, research needs to scrutinize and compare the medicinal claims of the pink mutant variety in the bio-diverse region of North-East India.

Keywords: Cleomaceae, *Cleome gynandra* Linn., Pharmacological, Phytochemicals, Pink mutant variety.

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INTRODUCTION

India is rich in its natural assets and considered as one of the 17 megadiverse nations of the world. The Indo-Burma, Western Ghats, and Eastern Himalayan Regions are the focused biodiversity hotspots of India. North-East (N.E) India is included the eight states encompassing Assam, Manipur, Arunachal Pradesh, Nagaland, Tripura, Meghalaya, Mizoram, and Sikkim and supports half of India's biodiversity. The region spreads more than 255,037 km^2 or about 7.7% of India's aggregate geological territory. N.E sates mostly rocky with plateaus, slopes and mountains overwhelming. Level marshes are at a top-notch covering just 27% of the region. Rainfall is exuberant with 6,300 mm yearly a normal event in the Cherrapunji region. In the rest of the N.E region, normal yearly precipitation ranges from 1000 to more than 4000 mm with the affluent occurrence during the monsoon periods of June–October. Originating from this rich tropical vegetation ranging from alpine, subtropical pine and mountain to evergreen and wet deciduous flourishes making the region a focus of worldwide biodiversity hotspot [1,2]. N.E states of India is honored with an extensive variety of physiographic and ecoclimatic conditions and above all is the topographical passage for quite a bit of India's endemic flora.

- Of the nine vegetation types of India; six important types are well established in N.E region.
- Of about 15000 flowering plant species, 8000 are found in the N.E area, which includes 500 pteridophytes, 40 gymnosperms, 825 orchids, 25 species of canes, 80 species of rhododendrons, and 60 bamboo species.
- An aggregate of 3624 species of insects, 236 species of fishes, 137 species of reptiles, 50 molluscs, 64 amphibians, 160 mammalian species, and 850 birds have been so far revealed, and the count is continuously rising.
- Out of 15 known species belonging to three families of primates,' 9 found in N.E region.
- Of 6 largest cats from India and the globe; N.E region registers 4, especially the clouded leopards.

In addition, the region represents an essential part of the Indo-Myanmar biodiversity hotspot, among the 25 world's biodiversity hotspots recognized to date over the globe [3]. 51 unique forest are found in this region, which incorporates tropical moist deciduous forests, evergreen semi-tropical forests, and evergreen wet tropical forests, moderate and subtropical, and mountainous forests [4]. Further, Fig. 1, depicts the percentage distribution of forest in N.E region and Table 1 summarizes eight states of N.E region with total area, climatic condition, and diversities of plant species.

Numerous valuable medicinal plants are practically associated culturally as well as socially. In addition, these plants are generally utilized for food, clothing, fuel, shelter, and different necessities of sustainable life by the local inhabitants and indigenous communities of this region [5]. Among extensive diversity of medicinal plants, *C. gynandra* has been found abundantly growing as a weed in common infertile land and in crop grounds [6,7].

Cleome gynandra Linn.

Cleome is a genus of the family Cleomaceae (formerly Capparaceae) is a major group of angiosperms, comprising many species found in tropical and sub-tropical areas of the globe. Cleomaceae family, encompassing flowering plants are Brassicales (or Cruciales) order, including more than 764 species belonging to 12 genera of which *Cleome* is the largest genus with about 601 species of ecological, ethnobotanical, and of course medicinal importance [6,8,9]. Different species of *Cleome* are therapeutically utilized in Island, North and Central America, Philippines, and Indo-China. In India, of 15 species 12 are reported in Maharashtra [10]. *Cleome* genus is under constant advancement; numerous species demonstrate a progressive movement from C3 photosynthesis to C4 photosynthesis and this developmental movement is indistinguishable to Brassicaceae individuals like *Arabidopsis thaliana.* There is extremely inadequate and scattered work in the genus, *Cleome*. Especially, the anatomical and physiological examinations in the species are uncommon [11]. *C. gynandra* is an

Table 1: Area, climatic condition, plant diversity in North Eastern states of India

States	Total area (sq. km.)	Climatic condition	Plant diversity specification
Arunachal Pradesh	83743	Yearly rainfall: ~ 1500–3800 mm. Temperature: ~ 0–31°C	~ 5000 flowering plants species, 238 are endemic to the state. The state has ~500 species of orchids and one of the orchid-rich state in India
Assam	78438	Yearly rainfall: ~ 2000–8000 mm. Temperature: ~ 5–32°C	Flowering plants ~3010 species, of which 102 species are endemic. State is rich in bamboo diversity ~42 species are found
Manipur	22327	Yearly rainfall: ~ 1300–2700 mm. Temperature: ~ 15–38°C	Flowering plants ~2500
Meghalaya	22429	Yearly rainfall: ~ 4000–11500 mm. Temperature: ~ 2–33°C	Flowering plants ~3500 species
Mizoram	21081	Yearly rainfall: ~ 2200–3500 mm. Temperature: ~ 11–29°C	Flowering plants ~2200 species
Nagaland	16579	Yearly rainfall: ~ 2000–3000 mm. Temperature: ~4–30°C	Flowering plants ~2250 species
Sikkim	7096	Yearly rainfall: ~ 2700–3200 mm. Temperature: ~ 0–28°C	Flowering plants ~4500 species
Tripura	10491	Yearly rainfall: ~ 2300–2500mm. Temperature: ~ 4–38°C	Flowering plants ~1600 species, of about 14% of species found is endemic

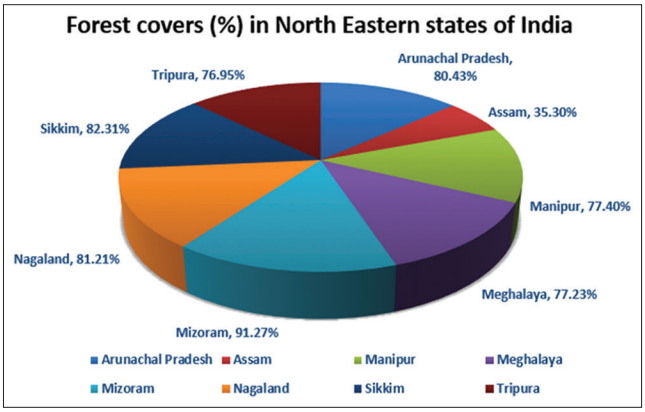


Fig. 1: The percentage distribution of forest in North-East region

opulently accessible species and matures as a weed in common sterile land and in crop grounds throughout the world. As a weed, it is generally found growing on fertile soils, particularly in those previously blended with animal fertilize, or with homestead disposed. Ideal growing conditions for *C. gynandra* require suitable soil moisture, high-intensity light and temperatures of ~25°C. In different countries, it is used to treat many diseases as traditional medicine, and it is additionally utilized as a part of different conventional culinary systems for it's astounding antioxidant and nutritional activities [12-14].

Synonyms of *Cleome gynandra* L. [9]

- *Gynandropsis gynandra* (L.) Briq.
- *Gymnogonia pentaphylla* (L.) R. Br. ex Steud.
- *Gynandropsis pentaphylla* Blanco.
- *Cleome pentaphylla* L.
- *Cleome pentaphylla* var. *glabra* Kuntze.
- *Pedicellaria pentaphylla* (L.) Schrank.
- *Pedicellaria pentaphylla* (L.) Schrank.
- *Pedicellaria triphylla* (L.) Pax.
- *Gynandropsis pentaphylla* (L.) DC.
- *Podogyne pentaphylla* (L.) Hoffmanns.
- *Gynandropsis heterotricha* DC.
- *Gynandropsis glandulosa* C. Presl.
- *Cleome acuta* Schumach. and Thonn.

Taxonomic position of *Cleome gynandra* L. is as follows

- Kingdom: Plantae
- Division: Angiosperms
- Class: Dicotyledones
- Order: Capparidales (Capparales)
- Family: Cleomaceae
- Genus: *Cleome*
- Species: *Gynandra*.

Plant distribution

C. gynandra is typically well-known herb in southern Africa reaching out from the Limpopo, the North-West, Mpumalanga, Gauteng, the Northern Cape, and Namibia. Being semi-cultivated, in the District of Eastern Cape, has most likely broadened its distribution. It is most likely a native of Africa and now broadly circulated in tropical and subtropical areas all through the world [6,15].

The species is also native to the following regions/countries [15]

- Northern Africa: Egypt and Mauritania
- Western Africa: Cameroon, Ghana, Guinea, Côte d'Ivoire, Mali, Niger, Nigeria, and Sierra Leone
- Central Africa: Angola, Burundi, and Zaire Eastern
- Africa: Ethiopia, Kenya, Somalia, Sudan, Tanzania, and Uganda
- African Islands: Madagascar, Mauritius, Reunion, and Seychelles
- Middle East: Oman and North Yemen
- Far East: Afghanistan
- Asia: Borneo, India, Java, Malaysia, Moluccas, Philippines, Sri Lanka, Sulawesi, and Thailand
- Australasia: Fiji.

Numerous species of the genus *Cleome* are discovered from India, but most normally available species are the *C. chelidonii* with blue flower and *C. viscosa* with a yellow flower. A careful scrutiny reveals that the species is available in Sri Lanka to India in whole Asia. A summarized finding is tabulate in Table 2 w.r.t the occurrence or distribution, habit, some morphological traits, and flowering period.

In Indian literature *C. gynandra* is distinguished by the accompanying vernacular names of the following:

Vernacular names in India [14]

Sanskrit: Pasugandhi, Ajagandha
Assamese: Bhutmulla
Bengali: Hurhuria, Shulte
English: Dog Mustard
Gujarat: Talvani, Dhelitalavan
Hindi: Hulhul, Hurhur, Kavalia
Kannada: Naram bele Soppu, Nayeetulasi
Kashmiri: Gandi Buti

Malayalam: Atunari vela
Marathi: Tilvan, Bhatvan, Mabli, Tilavana, Tilvant
Oriya: Anasorisia, Anasorisa, Hulhulia
Punjabi: Bugra
Tamil: Nal valai, Nal velai
Telugu: Vaminta, Vayinta.

This review endorses in N.E region of India the same plant abundantly found in pink mutant variety, Fig. 2 further illustrates the white; Fig. 2(a) and the pink; Fig. 2(b) mutant verities, respectively.

Phytochemical importance of *C. gynandra*

Qualitative phytochemical screening of the powdered leaf revealed the presence of following class of compounds summarized in Table 3 [16].

A good number of phytochemicals have been isolated from different parts of white mutant *C. gynandra* which confirms its current understanding of nutritional claims and pharmacological evidence, whereas a few compounds, namely, clenbuterol, stearin compound, bicyclohexyl derivatives, and (5Z,8Z)-3-hydroxypropyl dodeca-5,8-dienoate only been isolated from the pink mutant variety, only available in N.E states. Table 4 further summarizes the isolated phytochemicals from both the mutant varieties of *C. gynandra* with respective citations.

Pharmacological importance of *C. gynandra*

The pharmacological importance of *C. gynandra* is referred in Ayurveda; *Gulma* (tumor, irregularity, or diverticulosis), *Krmiroga* (worm infection), *Asthila* (Prostate enlargement), *Kandu* (pruritus), and *Karnaroga* (ear infections) [27,28]. The indigenous information of numerous traditional medicine has been figured, reported, and eventually wind up noticeably with composed frameworks of the drug, for example, Ayurveda, Unani, Siddha, and other indigenous traditional system throughout the world [8]. The following are some therapeutic investigation reported by various researchers from India and from other nations as well [14-24, 29,30]:

- Sap from leaves utilized as pain relieving agent, especially in cerebral pain.
- Sap from pounded leaves is pressed into ears, nostrils, and eyes to treat epileptic fits and ear infection.
- A decoction or mixture of bubbled leaves and/or roots is regulated to:
  - Encourage labor pain in pregnant ladies.
  - Treat stomach-throb and constipation.
  - Treat conjunctivitis.
  - Treat serious thread worm disease.
  - Relieve burning chest pains.
- The leaves have anti-inflamatory activities and are utilized to treat joint inflammation.
- Leaves are rubefacient and vesicant and used to treat neuralgia, otalgia, rheumatism, and stiffness. The leaves are rubbed on the affected parts.
- In Taiwan, it is utilized to treat looseness of the bowels, gonorrhea, fever, and rheumatoid arthritis. In India, the plant has been usually utilized as a rubefacient and anthelmintic agents. Leaves are applied directly over the injuries to prevent sepsis. The plant also used to treat piles, different stomach aches and in tumor. The juice of the root is utilized to treat fevers.
- Bruised leaves are applied to boils to stop pus discharge.
- Infusion from leaves is utilized to treat iron deficiency.
- Sap from the leaves used to cure intermittent intestinal sickness.
- Leaves are rubbed onto the skin to relieve pneumonia.
- An infusion of the leaves utilized as an eyewash.

Table 2: Summarized review of the specie available in Sri Lanka to India to whole Asia

Specifications	The plant *Cleome gynandra* Linn.
Native	Shri Lanka to India to whole Asia
Morphology	The erect plant is 250–600 mm tall
Soil type needed	Black mostly with waste place
Habitat	Annual herb
Leaves	Mostly 5 foliate pinnately compound; leaf stalk is 20–50 mm long with glandular hairs
Fruits	The fruits are in capsule form
Microscopic structures	Dark brown, oily; under microscope shows a number of fragments of epidermis; Leaf thickness ranges from 112 to 398 µm
Inflorescence	Corymbose-racemes
Flower color	White
Androecium	6
Gynoecium	Gynandrophore 1 cm long
Capsule (Length)	4–8 cm
Seed	Muricate, dark brown, globose 1.5 mm in diameter
Flowering and fruiting	August–December

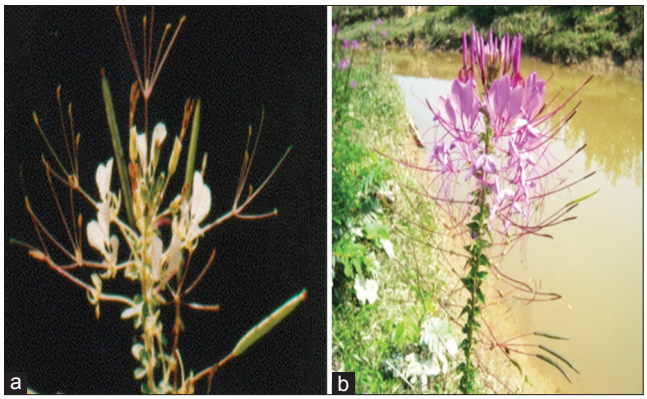


Fig. 2: Two mutant variety of *Cleome gynandra*. (a) White mutant *C. gynandra* in India, Sri Lanka to whole Asia. Source: [12] and http://www.ku.ac.th/AgrInfo/plant/plant2/p029.html. (b) Pink mutant *C. gynandra* only in North-East region. Source: [6]

Table 3: Qualitative phytochemical screening of the powdered leaf of *C. gynandra*

Phytochemicals	n-Hexane	Benzene	Chloroform	Acetone	Ethanol (90%)	Water
Alkaloids	-	-	-	-	-	-
Anthraquinons	-	-	-	-	-	-
Carotenoids	-	-	+	+	-	-
Cardiac glycosides	-	-	+	+	++	++
Cyanogenetic glycosides	-	-	+	+	++	++
Flavonoids	-	-	-	++	++	++
Phenols	-	-	-	++	++	++
Saponins	-	-	-	++	++	++
Sugars	+	++	++	-	-	-
Tannins	-	-	+	+	++	++
Triterpenes	-	-	+	+	++	++

++: Marked change,+: Moderate change, -: No characteristic change

Table 4: Brief review of the isolated phytochemicals from two mutant varieties of *C. gynandra* [6,16]

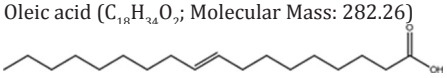
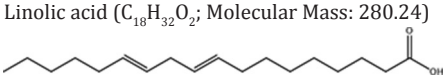
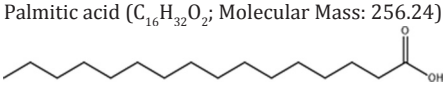
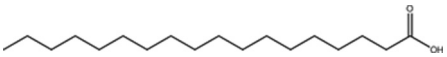
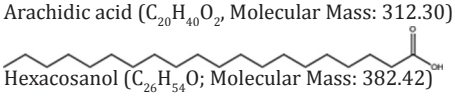
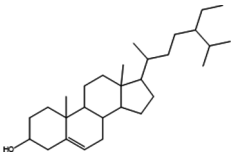
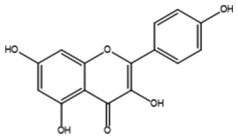
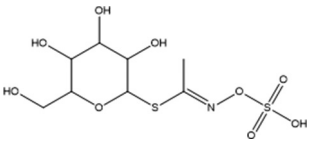
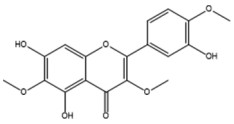
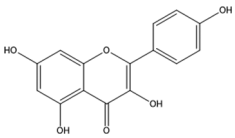
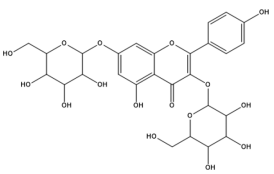
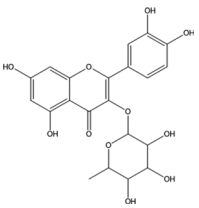
Plant part used	Phytochemicals	Relevant citation
Seeds oil	Oleic acid ($C_{18}H_{34}O_2$; Molecular Mass: 282.26)  Linolic acid ($C_{18}H_{32}O_2$; Molecular Mass: 280.24)  Palmitic acid ($C_{16}H_{32}O_2$; Molecular Mass: 256.24)  Stearic acid ($C_{18}H_{36}O_2$; Molecular Mass: 284.27)  Arachidic acid ($C_{20}H_{40}O_2$, Molecular Mass: 312.30) 	Misra and Dutt 1937 [17]
Defatted alcoholic extract of the seed	Hexacosanol ($C_{26}H_{54}O$; Molecular Mass: 382.42) β-sitosterol ($C_{29}H_{50}O$; Molecular Mass: 414.39)  Kaempferol ($C_{15}H_{10}O_6$; Molecular Mass: 286.05) 	Gupta, 1968 [18]
Methanolic extract of the leaf	Glucocapparine or methyl glucosinolate ($C_8H_{15}NO_9S_2$; Molecular Mass: 333.02) 	Saleh, 1976 and Hasapis, 1981 [19,20]
Leaf in Egypt	Centauridin ($C_{18}H_{16}O_8$; Molecular Mass: 360.08)  Kaempferol ($C_{15}H_{10}O_6$; Molecular Mass: 286.05)  Kaempferol 3,7-di-O-glucoside ($C_{27}H_{30}O_{16}$; Molecular Mass: 610.15)  Quercitrin ($C_{21}H_{20}O_{11}$; Molecular Mass: 448.10) 	Ali *et al.*, [21]

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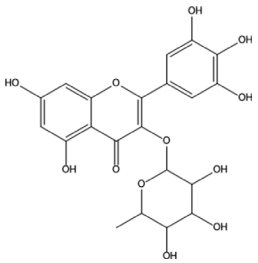
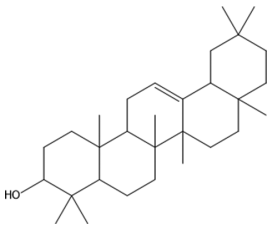
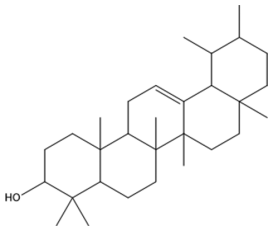
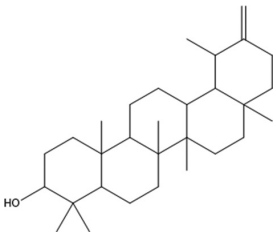
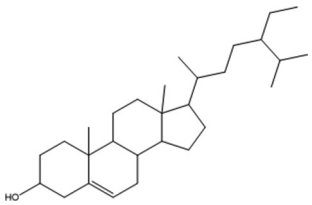
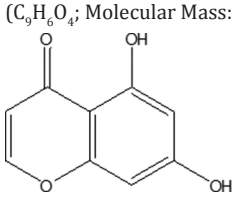
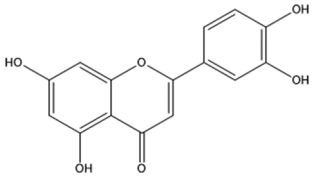
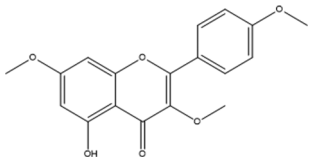
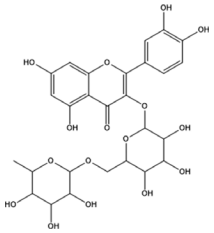
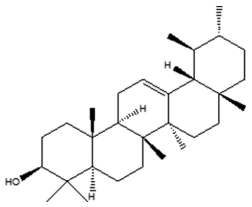
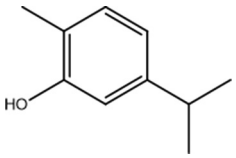
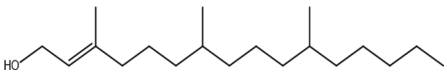
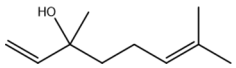
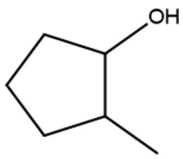
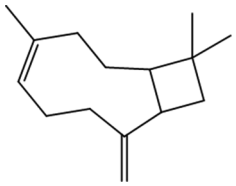
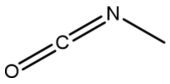
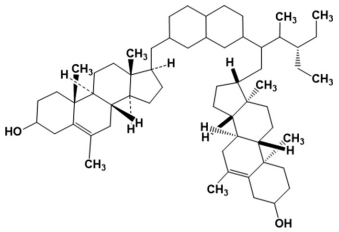
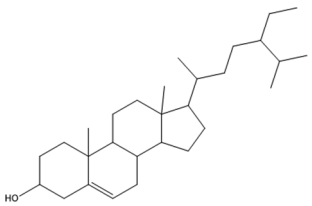
Table 4: (*Continued*)

Plant part used	Phytochemicals		Relevant citation
	Myricitrin ($C_{21}H_{20}O_{12}$; Molecular Mass: 464.10)	β-amyrin ($C_{30}H_{50}O$ Molecular Mass: 426.39)	
			
	α-amyrin ($C_{30}H_{50}O$ Molecular Mass: 426.39)	Taraxasterol ($C_{30}H_{50}O$ Molecular Mass: 426.39)	
			
	β-sitosterol ($C_{29}H_{50}O$; Molecular Mass: 414.39)		
			
	(Also isolated by Gupta, 1968)		
Methanolic extract of the defatted seeds	5,7-dihydroxy chromone ($C_9H_6O_4$; Molecular Mass: 178.03	Luteolin ($C_{15}H_{10}O_6$; Molecular Mass: 286.05)	Jain and Gupta; Rastogi *et al*. [22,23]
			
	5-hydroxy -3,7,4/-trimethoxy flavones ($C_{18}H_{16}O_6$; Molecular Mass: 328.09)		
			
Alcoholic extract fresh flower	Rutin ($C_{27}H_{30}O_{16}$; Molecular Mass: 610.15)		Ragunathan, *et al*., [24]
			

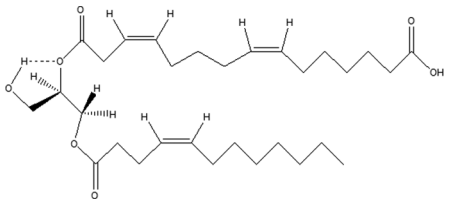
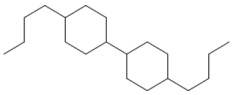
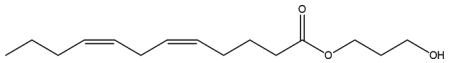
(Contd...)

Table 4: (*Continued*)

Plant part used	Phytochemicals	Relevant citation
Air dried whole plant (without seeds) petroleum ether extract	Cleogynol ($C_{30}H_{50}O$; Molecular Mass: 426.39) 	Das, *et al*., [25]
Essential oil analysis by GC-MS	Carvacrol ($C_{10}H_{14}O$ Molecular Mass: 150.10)  Trans-phytol ($C_{20}H_{40}O$ Molecular Mass: 296.31)  Linalool ($C_{10}H_{18}O$ Molecular Mass: 154.14  Trans-2-methyl cyclopentanol ($C_6H_{12}O$; Molecular Mass: 100.09)  β-caryophyllene ($C_{15}H_{24}$; Methyl isocyanate (C_2H_3NO; Molecular Mass: 204.19) Molecular Mass: 57.02)  	Lwande, *et al*., [26]
Argentation-TLC followed by re-crystallization of fractions of seed oil	Clenbuterol ($C_{60}H_{98}O_2$; Molecular Mass: 850.76)  β-sitosterol ($C_{29}H_{50}O$; Molecular Mass: 414.39)  (Gupta, 1968)	Roy, S, Ph.D Thesis 2007 [27]

(Contd...)

Table 4: (*Continued*)

Plant part used	Phytochemicals	Relevant citation
	Stearin compound ($C_{30}H_{50}O_7$; Molecular Mass: 522.36) 	
Aerial part of the plant	Novel bicyclohexyl derivate ($C_{20}H_{38}$; Molecular Mass: 278.30) 	Roy, S, Ph.D Thesis 2007 [27]
Steam distillate of aerial leaf by GC-MS	(5Z,8Z)-3-hydroxypropyl dodeca-5,8-dienoate ($C_{15}H_{26}O_3$; Molecular Mass: 254.19) 	Adhikari, *et al*., [6]

TLC: Thin-layer chromatography, GC-MS: Gas chromatography-mass spectrometry

- Seeds are anthelmintic and rubefacient and are consumed for the removal of roundworms, or a mixture is applied externally on the stomach as a painkiller.
- Seeds are blended with oil and applied to the scalp to treat headache.
- Mixture of seed controls coughing.
- Seeds are also utilized for veterinarians to treat stomach pains.
- Leaves and the plant have anti-ticks and fleas preventive properties.
- A decoction of roots is accounted for to have gentle febrifugal properties
- Anthelmintic properties own by roots.

As an anti-inflammatory agent

In 2008 group of scientists uncovered the anti-inflammatory action of *C. gynandra.* They utilized thermal stimuli in hotplate test and the writhing reaction of the tested animals to an intraperitoneal infusion. From the outcomes, it was clear that the aqueous extract, to an intraperitoneal infusion. From the outcomes, it was clear that a notable antinociceptive activity in the hotplate test and writhing response, which is similar to that of the standard. Studies show that different flavonoids, for example, luteolin, rutin, hesperidin, quercetin, and bioflavonoids produced substantial antinociceptive and anti-inflammatory activities [31]. A couple of reports on tannins as anti-inflammatory activities and antinociceptive properties. NSAIDs; nonsteroidal anti-inflammatory drugs in peripheral tissues can hinder cyclooxygenase, thus interfere transduction mechanism. The antinociceptive activity could be because of the flavonoid-mediated peripheral mechanism. Most of the NSAIDs have all around adjusted mitigating and ulcerogenic exercises, which are thought to be because of prostaglandins synthetase inhibitor activity [32-34].

As a free radical scavenging agent

The generation of free radicals has been concerned in the causation of a few sicknesses of referred to an obscure etiologies, for example, diabetes, cancer, rheumatoid arthritis, and so forth., and especially phytochemicals that can scavenge free radicals have extraordinary potential in protecting these ailments. The research trials on animal models showed an excellent radical scavenging capacity of *C. gynandra* alcoholic leaf extract on experimental rats at a dose of 150 mg/kg for a 30 days trial in induced arthritis rats. Furthermore, the leaf extract increased lipid peroxidase levels significantly. Glutathione peroxidase activities; reduced glutathione and superoxide dismutase activity were also decreased significantly. The free radical scavenging capacity of *C. gynandra* leaf extract was additionally confirm by histological examination [16,32,35].

As an anticancerous agent

Anticancer activity of methanolic extract of *C. gynandra* was assessed against Ehrlich Ascites Carcinoma cell line at the doses of 400 and 200 mg/kg body weight intraperitoneally. The outcome indicated significant decline in tumor volume, viable cell count, tumor weight, and raised the life expectancy of tumor-bearing mice when compared with normal control mice. Hemoglobin, red blood cell, white blood cell, and lymphocyte count returned to the normal level in treated mice. Result reveals the extract has potent dose-dependent anticancer activity [36].

As an Immunomodulator

Aqueous and alcoholic extracts of *C. gynandra* significantly diminishes the level of serum immunoglobulin G (IgG) in correlations with the level of IgG. Both aqueous and alcoholic extracts separately influenced IgM and IgG levels. Among the two tested samples, alcoholic extract demonstrated better activity even with lower amounts. The general pharmacological examinations strongly show the immunosuppressant activity of the alcoholic extracts and the aqueous extract of *C. gynandra*. Therefore, T cell-dependent antigen shown the inhibitory effect of both the extracts on T cells. The ethanolic extract of *C. gynandra* demonstrations better action; inhibition about 92.74% cell-induced hypersensitivity in the albino rat to evaluate the impact of the division on cell-mediated immunity [12].

As an antidiabetic agent

Herbal formulation of plants containing minor and trace elements in bioavailable that positively impacts glucose resistance and potentially increases self-ability to improve the diabetic condition. Essential nutrients such as Mg, Na, Fe, Ca, Se, Cu, and Zn has confirmed that many Indian herbs like *Eugenia jambolana* responsible for curing diabetes by providing fundamental supplements [37].

In some place of western Orissa, the leaves and roots are utilized by tribal people and conventional healers as an antidiabetic medicine. The reason of *C. gynandra* to use in diabetes might be anticipated for its antioxidant activities, its nutritive capacity, and immunomodulatory properties. The glucose oxidation enhancing pathway, because of the dynamic phytochemicals are probably to be its polyphenolic compounds. A diabetic inconvenience like diabetic nephropathy (DN) is a serious and life-threatening complexity of chronic diabetes. As one of the primary factor of renal disorder, the prevention and treatment of DN in its beginning phase, and the decrease of DN advancement are of most extreme significance and are emerging subjects current research. Natural products enriched with antioxidant

and anti-inflammatory capacities may offer a chance of synergistic treatment for this situation. The various plant phytocompounds supplementation does not have any huge effect on plasma glucose but rather altogether found to diminish malondialdehyde plasma level and the general redox parameters together with a fractional moderation of proteinuria. The experimental results demonstrate that, other than the control of glycemia, interference of phytochemicals with antioxidant and anti-inflammatory properties may have advantageous impacts when coordinated in the standard of the therapeutic regimen. Polyphenolic constituents and flavones' intervention of *C. gynandra* have been appeared to be in response for the antioxidant property and have been attributed to different properties such as anticancer, antidiabetic, and inhibition of cardiovascular diseases. The aqueous and alcoholic extracts of *C. gynandra* are a possible foundation of natural antioxidants such as polyphenols and flavonoids. This can be utilized for an effective antioxidant compound that can shield from oxidative. Until April 2014 no hypoglycemic properties were considered or demonstrated. Ravichandra *et al*., 2014, concentrated the antidiabetic and antilipidemic properties of *C. gynandra* in alloxan-induced diabetic rats. Ravichandra *et al*. concentrated the antidiabetic a hostile to dyslipidemic movement of *C. gynandra* plant extricates in alloxan incited diabetic rats. The effect on the oral administration of alcoholic extract significantly reduced serum glucose and lipid profiles in diabetic control when compared with normal groups. Examination recommended that alcoholic extract of *C. gynandra* restrains blood glucose levels and dyslipidemia in diabetes rats. Therefore, leaf decoction of *C. gynandra* folk claims has been ascertained. Further, the mechanism of lowering blood sugar may be attributed to the presence of micronutrients and polyphenolics [10].

CONCLUSION

Over the past two decades, an expanding body of evidence from epidemiological and laboratory studies of the plant *C. gynandra* L. have demonstrated some nutritional aspect and identified ingredients with potent therapeutic values. Scientific perusal reveals *C. gynandra* has an excellent an indigenous medicine and act as an inflammatory, radical scavenging, anticancerous, immunomodulatory, and antidiabetics agent. Furthermore, *C. gynandra* has been used as several other ailments.

Yet, research needs to focus on the isolation of nutritional and therapeutic principles of *C. gynandra*. Survey of literature motivates both Re-search and Research of the plant to add new empirical solutions of many life-threatening diseases. Evaluation of synergistic/antagonistic outcome may include new herbal medicines to health-care management systems. Because most of the reports in India on this plant that has been carried out on the white mutant variety. However, in North-Eastern region the same plant abundantly found only in pink mutant variety. Extensive research needs to scrutiny this diversity of the plant in this biodiverse region.

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